abs conv. $\sum |a_n|$ conv., $\sum a_n$ must also conv.

cond. conv $\sum |a_n|$ diverges but $\sum a_n$ conv.

neither conv.
(both div.)
$\sum |a_n|$ div, $\sum a_n$ div

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abs. conv on $(-2,-1)$

no conditional conv.

$1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} \ldots = 2$ conv. to 2

$1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} \ldots$ diverges

$\sum \frac{1}{n^p}$ Harmonic

$\sum \frac{1}{n}$ p series, $p=1$ div.

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60. a) $\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} \cdot (-1)^{n-1}\frac{x^n}{n}$

b) $\lim_{n\to\infty}\left|\frac{x^{\cancel{n+1}}}{n+1}\cdot\frac{n}{\cancel{x^n}}\right| = |x| < 1$ ($\to 1$)

ratio test

endpts: $\boxed{-1 < x \leq 1}$

$x=1$ $\quad 1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4}\cdots$

alt. harmonic conv. by AST

$x=-1$ $\quad -1 - \frac{1}{2} - \frac{1}{3} - \frac{1}{4}\cdots$

$-\left(1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4}\cdots\right)$ div.

- harmonic

conv absolutely on $(-1, 1)$

Conv conditionally at $x = 1$

$(-1, 1]$

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truncation error

~~.4055~~ $\quad$ .4073

$\cancel{\ln\left(\frac{3}{2}\right)} \approx \frac{1}{2} - \frac{(1/2)^2}{2} + \frac{(1/2)^3}{3} - \frac{(1/2)^4}{4} + \frac{(\frac{1}{2})^5}{5}$

$\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4}\cdots$

$x = \frac{1}{2}$

$\frac{f^5(a)\,x^5}{5!}$ $\quad \epsilon < \left|\frac{(1/2)^6}{6}\right|$

~~.0018~~ $\quad$ .0026

$\epsilon < \left|M\frac{x^{n+1}}{(n+1)!}\right|$ $\quad \ln\left(\frac{3}{2}\right) \approx .4073 \pm .0026$

M is the max value of $f^{n+1}(x)$

$\frac{Mx^6}{6!}$ $\quad$ m is max of $f^6(x)$

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$$\epsilon < M \frac{f^{n+1}(a)}{(n+1)!}$$

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60. a) $\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \frac{x^5}{5} \dots (-1)^{n-1}\frac{x^n}{n} \dots$

$\sum_{n=1}^{\infty} (-1)^{n-1} \frac{x^n}{n}$

b) ioc $\lim_{n\to\infty} \left| \frac{x^{\cancel{n+1}}}{n+1} \cdot \frac{n}{\cancel{x^n}} \right| = |x| < 1$

$\boxed{-1 < x \leq 1}$

endpts

$x=-1$ $\quad -1 - \frac{1}{2} - \frac{1}{3} - \frac{1}{4} \dots$

$-(1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} \dots)$ neg harmonic diverges

$x=1$ $\quad 1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \dots$ alt. harmonic series converges by AST

conditional conv at $x=1$

$\sum |a_n|$ diverges

$\sum a_n$ converges

Conv. abs. at $(-1,1)$

ioc: $(-1,1]$

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$$\ln\left(\tfrac{3}{2}\right) \approx \frac{1}{2} - \frac{(1/2)^2}{2} + \frac{(1/2)^3}{3} - \frac{(1/2)^4}{4} + \frac{(1/2)^5}{5} - \frac{(1/2)^6}{6}$$

$$\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} \cdots$$

$$x = \frac{1}{2}$$

$$\epsilon \le \left| \frac{(1/2)^6}{6} \right|$$

$$\epsilon \le .0026$$

.0018

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